

What is claimed is:

1. A method for carrying out a machining operation upon a workpiece using a machining tool controlled by a computer, said computer controlling said machining tool with a control program, said method comprising the steps of:

creating an inspection data file for said workpiece;

5 using said data file to create a model of said workpiece with said control program;

selecting data points in said model to identify the surfaces of said workpiece to be machined; and

machining said identified surfaces with said machining tool by controlling said machining tool with said control program.

2. The method of Claim 1 wherein a succession of said machining operations are carried out upon said workpiece.

3. The method of Claim 1 wherein said machining operation is selected from the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

4. A method for manufacturing a workpiece from a blank, said method comprising the steps of:

using a first computer program to create a first data set that identifies the contours of the workpiece;

5 using said first data set to set the operating parameters of a workpiece-shaping device;

cutting a prototype workpiece from said blank with said workpiece-shaping device;

using a second computer program to generate a second data set for the purpose of measuring and inspecting said prototype workpiece;

measuring and inspecting said prototype workpiece using a device operated by said

10 second computer program;

using a third computer program to create a digital model of the contours of said workpiece; and

using said third computer program and said model to operate a computer-controlled machining device to perform selected machining operations on selected of said contours.

5. The method of Claim 4 wherein a succession of said machining operations are carried out upon said workpiece.

6. The method of Claim 4 wherein said machining operation is selected from the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

7. A method for manufacturing a complex spiral gear from a blank, said method comprising the steps of:

using a first computer program to create a first data set that identifies the contours of said gear;

5 using said first data set to set the operating parameters of a gear-cutting machine;

cutting a gear from said blank with said gear-cutting machine;

using a second computer program to generate a second data set for the purpose of measuring and inspecting said gear;

measuring and inspecting said gear by a gear-inspection machine operated by said second  
10 computer program;

mounting said gear to a rotatable, indexable chuck;

using a third computer program to generate a computer model of the contours of said gear,

said third computer program adapted to operate said indexable chuck and a robotic work  
15 arm;

mounting a first selected machining tool on said robotic work arm;

using said third computer program to operate said work arm to bring said first machining tool into contact with a first selected portion of said gear contours;

conducting a first machining operation upon said first gear contour portion;

20 operating said indexable chuck to bring a second selected portion of said gear contour into position to be machined;

using said third computer program to operate said work arm to bring said first machining tool into contact with said second selected portion of said gear contours;

conducting said first machining operation upon said second gear contour portion; and

25 continuing to reindex and machine said gear until all contours desired to be machined have been machined.

8. The method of Claim 7 including the steps of:

removing said first machining tool and replacing it with a second machining tool to carry out a second machining operation;

30 using said third computer program to operate said work arm to bring said second machining tool into contact with a third selected portion of said gear contours;

conducting said second machining operation upon said third gear contour portion;

operating said indexable chuck to bring a fourth selected portion of said gear contour into position to be machined;

35 using said third computer program to operate said work arm to bring said second machining tool into contact with said second selected portion of said gear contours;

conducting said second machining operation upon said fourth gear contour portion; and

continuing to reindex and machine said gear until all contours desired to be machined have been machined.

9. The method of Claim 7 wherein said machining operation is selected from the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

10. The method of Claim 8 wherein said machining operation is selected from the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

11. A method for manufacturing a complex spiral gear from a blank, said method comprising the steps of:

using a first computer program to create a first data set that identifies the contours of said gear;

5 using said first data set to set the operating parameters of a gear-cutting machine;

cutting a prototype gear from said blank with said gear-cutting machine;

using a second computer program to generate a second data set for the purpose of measuring and inspecting said prototype gear;

10 measuring and inspecting said prototype gear with a gear-inspection machine operated by said second computer program;

correcting any detected errors in said prototype gear by resetting said gear-cutting machine operating parameters and manufacturing a second prototype gear;

repeating said prototype manufacture and inspection steps until a final of said prototype gears meets desired gear specifications;

15 using a third computer program to generate a computer model of the contours of said

final prototype gear,

said third computer program adapted to operate an indexable chuck and a robotic work arm;

using said gear-cutting machine parameters to cut a production gear;

20 mounting said production gear to said rotatable, indexable chuck;

mounting a selected machining tool on said robotic work arm;

using said third computer program to operate said robotic work arm to bring said machining tool into contact with a first selected portion of the contours of said production gear;

carrying out a first machining operation upon said first production gear contour portion;

25 operating said indexable chuck to bring a second selected portion of said production gear contour into position to be machined;

using said third computer program to operate said work arm to bring said machining tool into contact with said second selected portion of said production gear contours;

carrying out said first machining operation upon said second selected production gear

30 contour portion; and

continuing to reindex and machine said production gear until all contours desired to be machined have been machined.

12. The method of Claim 11 wherein a succession of said machining operations are carried out upon said workpiece.

13. The method of Claim 11 wherein said machining operation is selected from the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

14. Apparatus for manufacturing a workpiece from a blank, said apparatus comprising:

a cutting machine having machine settings adjustable to cut the contours of said workpiece from said blank;

a first computer program to create a first data set that identifies said contours of said workpiece,

said cutting machine settings determined by said first data set;

an inspection machine adapted to perform measurements upon said workpiece contours,

a second computer program to transform said measurements into a second data set;

a robotically-controlled machining arm,

said arm adapted to receive and operate a multiplicity of machining tools responsive to a third computer program;

an indexable chuck adapted to hold said workpiece and rotate said workpiece to bring said workpiece into a selected position;

a third computer program to control the movements of said arm and said chuck,

said third computer program adapted to use said second data set to control said chuck and said arm whereby a selected of said tools is brought into contact with a first selected portion of said contours to carry out a machining operation upon said contour and said chuck is operated to bring successive portions of said contours into position to be machined until all contours desired

to be machined have been machined.

20 15. The apparatus as recited in Claim 14 further comprising a work cabinet within which said arm and said chuck are positioned.

16. The apparatus as recited in Claim 15 further comprising means for collecting dust and debris created by said machining operation,

said collecting means including a hood forming the upper portion of said cabinet,

an air inlet formed through said hood;

5 a cabinet base having an air outlet;

a vacuum filtration unit; and

a duct extending from said air outlet to said filtration unit.

17. The apparatus as recited in Claim 14 further comprising means for cooling said workpiece during said machining operation;

said cooling means including means for supercooling ambient air;

means for directing said supercooled air to impinge upon said workpiece proximate the

5 site of said machining operation.

18. The apparatus of Claim 14 wherein said machining tools include tools to carry out the operations of chamfering, deburring, honing, reaming, grinding, polishing, buffing and drilling.



19. Apparatus for manufacturing a complex spiral bevel gear from a gear blank, said apparatus comprising: